Indian Museum Notes

V. 2 no. 3 1891

INDIAN MUSEUM NOTES.

ISSUED BY THE TRUSTEES.

VOLUME II.—No. 3.

ON

WHITE INSECT WAX IN INDIA.

Published by Authority of the Government of India, Revenue and Agricultural Department.

CALCUTTA.
PRINTED BY THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1891.

Price Eight Annas.

Vol. II.] [No. 3.

INDIAN MUSEUM NOTES.

WHITE INSECT WAX IN INDIA.

[*With one Plate.*]

Preliminary.

In the early part of 1891 the Trustees of the Indian Museum undertook, at the suggestion of the Government of India in the Revenue and Agricultural Department, to furnish a report upon the subject of white insect wax in India. Attention had previously been drawn to the subject by the authorities of the Royal Botanical Gardens at Kew, as there is said to be a considerable demand for the wax owing to its property of "breaking the grain" of otherwise crystalline substances and thus rendering them suitable for candle-making. The following report therefore has been drawn up in the Entomological Section of the Indian Museum, and is founded, partly upon the specimens and replies furnished by the Forest Officers of the Central Provinces and Bengal, in answer to a circular letter addressed to them by the Inspector General of Forests, and partly upon information gathered from specimens, already preserved in the Museum collection, and from the papers previously published upon the subject. Help in the chemical and botanical examination of the specimens has been kindly afforded by Mr. T. H. Holland of the Geological Survey and Dr. D. Prain of the Botanical Gardens.

The occurrence of the insect in India.

The white wax of commerce is produced by one of the Coccidæ insects, known to entomologists as *Eriocerus pela*. This insect has long been cultivated in China, where it yields a large amount of wax, which is used chiefly in candle-making, though the extent of the industry is said to have fallen off considerably of late years, owing to the introduction into China of kerosine oil, which has largely taken the place of the candles previously in use.[1] So far as our present information goes, the insect which produces white wax in China does not occur in India, but it has long been known that an insect, closely related to it, is occasionally to be met with, especially in the jungles of Southern and Central India. This insect is the one referred to by Dr. Watt in his paper[2] on candles. It was originally described in the year 1790, under the name of *Coccus ceriferus*,[3] and is known to modern entomologists as *Ceroplastes ceriferus*.[4] It produces a

[1] Hosie: *Three Years in Western China*, London, 1890.

[2] *Vide* Dr. Watt's Dictionary of the Economic Products of India.

[3] J. Anderson: *Monographia Cocci ceriferi*, Madras, 1790.

[4] Signoret: Ann. Soc. Ent. France (5), vol. ii, p. 40 (1872).

certain amount of wax, but is very rare and has never been utilised commercially. It was shown too, by Dr. Pearson,[1] as long ago as the year 1794, that its wax is not altogether suitable for candle-making, as both the wax itself, and also mixtures of the wax with olive oil, when made into candles, burn with a dim smoky light, and give off a resinous odour.

A good deal of confusion in our knowledge of the matter has arisen from the fact that a totally distinct insect, which is known to entomologists as *Phromnia marginella*, produces considerable quantities of a white sugary secretion, which has no connection with wax, but on the contrary, is totally useless for candle-making, thongh it has sufficient superficial resemblance to white wax to have often been mistaken for it. This fact not only accounts for many of what would otherwise appear to be hopeless contradictions in the reports of different observers on the subject, but has also led to the supposition that white wax is to be procured in India in very much larger quantities than is really the case. The mistake seems to have originated in the figures and description given of the White Wax Insect of China, in the year 1797, by Sir George Staunton,[2] this being the origin of the more elaborate figures and description published in Westwood's edition of Donovan's Insects of China[3]; in each case an insect closely allied to *Phromnia marginella* being erroneously described as the White Wax Insect of China. The error was very clearly pointed out in the year 1843 by Captain Hutton,[4] but the mistake, once made, seems to have cropped up again and again, the belief in it being further extended by some observations made, about the year 1850, by Dr. Charles Murchison.[5] Dr. Murchison examined the flocculent appendages attached to the bodies of the larvæ of an insect, which, from his description, seems to have belonged either to the species *Phromnia marginella* or to something very much like it, and he found that these appendages consisted of what he believed to be wax. An examination, recently made by Mr. Holland of the flocculent appendages of larvæ of *Phromnia marginella* preserved in the collections of the Indian Museum, has not confirmed Dr. Murchison's observations.[6]

[1] "Observations and experiments on a Wax-like Substance resembling the *Pela* of the Chinese, collected at Madras by Dr. Anderson, and called by him, 'White lac'": Philos. Trans., Royal Soc. Lond., vol. 84, p. 383 (1794).

[2] Embassy to China, London, 1797, vol. i, p. 353.

[3] London, 1842, pl. 17.

[4] Journ. As. Soc. Bengal, vol. xii, p. 898 (1843).

[5] Proc. Linn. Soc. Lond., vol. ii, p. 379 (1848—55).

[6] The flocculent matter attached to the specimens preserved in the Indian Museum collection consists of fibrous matter which not only refuses to melt, but, on the contrary, decomposes when heated, does not dissolve in naphtha, and under the microscope appears to consist of minute curved filamentous particles. That observed by Dr. Murchison, on the other hand, melted on heating into transparent colourless wax, which was readily soluble in naphtha and which crystallised on cooling, into acicular crystals, arranged in stellate masses, this form of crystalisation being one readily observable in the wax secreted by *Ceroplastes ceriferus*.

But even in the event of the flocculent appendages being found in some cases to contain wax, the quantity in which they occur is so small that they can be of no practical value; and the only reason for calling attention to them in this notice is owing to the fact that the sugary secretion, which is produced in considerable quantities by the insect, is liable to be confounded with the flocculent matter with which the larvæ are clothed. The scarcity of the White Wax Insect in India is remarkably illustrated by the material which has recently been collected by the officers of the Forest Department. This material, which has been forwarded to the Indian Museum, consists of four specimens, three of them connected with *Phromnia marginella*, while the fourth specimen is the only one which represents the White Wax Insect, and even it comprises only about a score of individuals, which would altogether yield but a minute quantity of the wax.

Phromnia marginella is so entirely different, both in its habits and appearance, from the White Wax Insect, *Ceroplastes ceriferus* that it is easy in most cases to make out which of the two species is referred to in the papers which have been published on the subject. In order, therefore, to prevent further confusion between the two insects, they are both included in the following *résumé*, which is accordingly arranged under the headings of *Ceroplastes ceriferus* and *Phromnia marginella*.

CEROPLASTES CERIFERUS.

The specimens of *Ceroplastes ceriferus* that have been forwarded to the Museum in connection with this investigation consist of about a score[1] of scales found by Mr. W. P. Thomas, Deputy Conservator of Forests, Hoshangabad, Central Provinces. Mr. Thomas found them in February 1889 on one of the hill spurs of the Panchmari range near Mogra, on saplings of *Terminalia chebula*, *Buchanania latifolia*, and *Terminalia tomentosa*,[2] and he reports that the insect was very scarce and only found after long search, while the natives knew nothing at all about it. The wax has been kindly examined by Mr. T. H. Holland, who reports on it as follows:—

"The wax occurs on the twigs in small mounds of dull, buff colour and puckered surface, apparently from drying. Under the thin crust the material is light pink in colour and presents a waxy lustre, with, also, a pleasant smell.

"The wax melted at 140° F. (60° C.) to a clear liquid, and, on cooling, produced microscopic, spherulitic growths of radially arranged, polarising crystals.

"About 20 per cent. of the material dissolved in cold absolute alcohol; but it was almost completely soluble in boiling alcohol, from which it is again precipitated as a

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[1] Of these three have been preserved in the collections of the Indian Museum for reference.

[2] The leaves sent with the specimens have been kindly examined by Dr. D. Prain, who identifies them as belonging to the species *Buchanania latifolia*, Roxb., and *Terminalia chebula*, Roxb.

white opalescent cloud on addition of cold water, and is not again cleared by boiling. The wax is soluble in benzol.

"The specific gravity at 84°F. was 1·04 (determined by suspension in a solution of salt).

"As an average of two determinations, the amount of moisture was found to be 10·4 per cent., but the discrepancy between the two results (9·8 and 11·0) was no greater than one would anticipate from the appearance of the specimens.

"By the action of strong nitric acid the wax was decomposed to a yellow solution, with a faint aromatic smell; but the quantity at my disposal was too small to determine the products of oxidation, which might be of interest to compare with the results obtained by a similar treatment of *Pela*, the Chinese wax investigated by Buckton. The few determinations made do not closely agree with the properties of cerotate of ceryl $(C_{59}H_{108}O)_2$ the principal constituent of Chinese wax."

Ceroplastes ceriferus was originally described in the year 1790 by Dr. Anderson,[1] who found it in Madras. It was afterwards figured and described by Westwood,[2] whose description, however, as quoted by Signoret,[3] is confined to the mass of white wax, which is irregularly hemispherical in shape, of the size of a large split pea, encloses the shell of the female insect, and was originally found in Madras on the twigs of a species of *Celastrus*, which is referred to as *Celastrus ceriferus*. Dr. Anderson's original paper has not been found, but Dr. Pearson[4] gives a detailed account of Dr. Anderson's white wax, which was submitted to him for examination. According to Dr. Pearson, Dr. Anderson procured some pounds' weight of the wax and sent it in the year 1792 to the Royal Society, at the same time complaining that the children, whom he employed to gather it, were tempted by its sweetness to eat so much of what they collected as materially to diminish the produce of his trees; the wax was also believed to possess medicinal qualities. Pearson found that the raw wax in its dry state has a saltish and bitterish taste, and in the mouth is soft and tough, having thus lost the sweetness which characterises it in its fresh state. It contains a large proportion of a watery liquid, which has a slightly saltish taste. In its raw state the wax is as light, or lighter than as, bees' wax, but, after being melted and purified by straining, it sinks in water, and is therefore specifically heavier than most bees' wax. Two thousand grains of the raw article, when melted and purified by straining through fine cloth, produced 1,220 grains of wax. This purified wax was yellow in colour, hard and brittle, with scarcely any taste, melted at a temperature of between 145° and 146° Fahrenheit, was soluble in volatile oil of turpentine, and partially soluble in alcohol. Candles, with cotton wicks, were made of the purified wax; they burnt more rapidly, but were thought to give less light than wax candles of the same size; they also smoked and produced a resinous smell. Saturated

[1] *Monographia cocci ceriferi*, Madras, 1790.

[2] Gardener's Chronicle, 1853, page 484.

[3] Ann. Soc. Ent. France, ser. 5, vol. ii, page 40.

[4] Philos. Trans. Royal Soc. London, vol. 84, page 383 (1794).

solution of the wax in alcohol, when spread upon surfaces of paper, cloth, and wood, left, on drying, a thin coat of resinous matter, which, however, was not bright or smooth, so this solution does not afford a good varnish. The wax, when united with olive oil, became whiter in colour, and as soft as bees' wax, but it burnt, as before, with an unsteady light, smoking and producing a resinous smell. Dr. Pearson concludes that bees' wax and white wax are homogeneous substances, formed of very much the same constituent parts, the proportion of these parts however being very different in the two substances.

According to an account published in the Journal of the Agri.-Horticultural Society of India, Volume V, page 76 (1873—78), the species was again brought to notice in the year 1875, when Mr. Peppe forwarded specimens which he had found upon *pepul* twigs in Chota Nagpur, and noticed that he had also found it upon mango and *arjoon* trees. The specimens were identified by Mr. F. Moore, who also had the wax analysed, the following being an abstract of the analysis furnished by him :—

" Wax, of a dull opaque pale brown colour. The outer shell, darker and somewhat translucent. Moderately hard and brittle, of somewhat pleasant smell. On crushing in a mortar minute drops of water made their appearance. On heating it spluttered much, owing to the disengagement of steam. At 55°C. it melted to a clear liquid with a slightly flaky deposit. 0·5868 grm., burnt, left an unweighable trace of ash. Absolute alcohol dissolved 34 per cent. Boiling absolute alcohol dissolved 98·08 per cent. In benzine the wax was very easily soluble, with the exception of a little brownish matter. In ether it dissolved freely, but not entirely. In essence of turpentine, and also in carbonic sulphide, it was very sparingly soluble. The percentage of water varied from 11·02 to 13·16 in the specimens examined. Organic analysis gave, in 100 parts of the wax, carbon from 78·57 to 78·79, hydrogen 13·46 to 13·08, oxygen 7·97 to 8·13, and the wax therefore was supposed to consist of a compound of 13 atoms of carbon, 26 atoms of hydrogen, and 1 atom of oxygen."

The insect does not seem to have been again noticed until 1889, when a few specimens were sent to the Indian Museum from the Kangra Valley, where they were found in small numbers upon tea bushes. In this case the specimens were identified by Mr. W. M. Maskell, but nothing was ascertained regarding the habits or transformations of the insect.

PHROMNIA MARGINELLA.

There is some confusion in the synonymy of the insect which produces the white sugary secretion in India, but it is undoubtedly the *Cigale phalenoide-verte*, described and figured in the year 1788 by Stoll. (*Cigal*, p. 50, pl. 11, fig. 54), and quoted in 1791 by Olivier (*Encyclop. Meth. Ins.* vi, p. 575, No. 43), under the name of *Fulgora marginella*, also in 1862 by Stål (Öfvers. K. Sv. Akad. Stockholm, xix, p. 490), under the name of

Phromnia marginella.[1] In the Asiatic Researches, (Volume 14, p. 182, published in Calcutta in the year 1822, Major-General T. Hardwick describes and figures an insect under the name of *Chermis mannifer*,[2] which is probably identical with *Phromnia marginella*, Oliv. But by far the best account of the insect is given by Captain T. Hutton in the Journal of the Asiatic Society of Bengal, vol. xii, p. 898, Calcutta, 1843, where the name attributed to the species is *Flata limbata*.

The insect was found by Captain Hutton on the lower slopes of the Mussoorie Hills in the North-West Provinces, the sugary secretion being only obtainable throughout the dry weather from January to June, as it gets washed away by the first heavy rain that falls upon it. According to Captain Hutton the eggs hatch in December, and the larvæ cluster like sheep upon the food plant. They feed by sucking up the juices of the leaves, and moult several times, gradually increasing in size until the setting in of the rainy season in June, when winged imagos begin to emerge. In the imago the front wings are grass green, with anterior margins red, the posterior wings are milk white, the body is greenish, and the abdomen is generally covered up with white flocculent matter similar to what is found upon the larvæ. The eggs are laid in considerable numbers in the bark of the twigs, a slight swelling of the wood often taking place where the eggs have been laid. The imagos

[1] In his *Entomologia systematica* published in the year 1794, Fabricius notices that his *Cicada limbata* from South Africa is identical with Stoll's species from Ceylon. There would seem, however, to be some doubt upon this point owing to the geographical position of the two localities. The references to *Cicada limbata* are as follows:—

Cicada limbata, Fabr., Sp. Ins. ii, p. 322, No. 3 (1781).
„ „ „ Ent. Syst. iv, p. 27, No. 3 (1794).
Flata limbata, Fabr. Syst. Rhyn., p. 46, No. 6 (1803).

In the British Museum Catalogue of Homoptera, published in 1851, further confusion has arisen between *Phromnia marginella* and *Flata nigricornis*. The latter is a species which differs very markedly from *Phromnia marginella* in having the forewing brown with black dots along the posterior margin, instead of its being bright green with anterior margin red, as in *P. marginella*. As far as has been made out, the references to *Flata nigricornis* are as follows, though the diversity in the localities from which it is recorded, are so remarkable as to seem to point to some confusion in identification:—

Flata nigricornis, Fabr., Syst. Rhyng., p. 45, No. 1, 1803, America.
„ „ Donov. Ins. China, p. 40, pl. 17, 1842, China.
Cigale portelaine, Stoll., Cigales, p. 101, pl. 26, fig. 145, 1788, Africa.
Fulgora pallida, Oliv., Encyclop. Meth. Ins. vi, p. 575, No. 42, 1791, Africa.

[2] This insect was found upon a species of *Celastrus* in the neighbourhood of Pachmari and is referred to by Blanchard (Bull. Soc. Zool. de France, 1883, p. 277) as synonymous with the Scale insect *Coccus manniparus* described by Ehrenberg (Hemprich and Ehrenberg's *Symbolæ physicæ*, vol. iii, pl. x, 1829) as responsible for the sugary secretion which is collected at the present day by the Arabs from the *Tamarix gallica* plant in Sinai, and which is supposed to be identical with the *manna* eaten by the children of Israel in the wilderness. A comparison however of the figures given by Ehrenberg and Hardwick shows clearly that the insects they respectively describe are totally distinct from each other.

move but little from the food plant and often live on until after their eggs have hatched in the cold weather. The larvæ, and to a less extent the imagos, are covered with masses of white flocculent matter, which is thought to be secreted by small glands distributed over the abdomen, and opening by minute pores in the integument. The sugary matter is said to be excreted in a liquid state by the larvæ, and drops on to the leaves, where it hardens. Little is known of the method of its origin, but it is likely to be secreted by the large gland-like organs which are situated on either side at the extremity of the abdomen in the larvæ (Fig. 2 *d*).

The specimens, furnished by the Forest Department, consist of larvæ and pieces of sugary secretion found by Mr. W. P. Thomas, in February 1889 in the Narsingpur district of the Central Provinces. The insects were found on the green succulent coppice shoots of *Elæodendron roxburghii*, growing on elevated ground, and the sugary secretion was found coating the leaves below where the larvæ were feeding. Mr. Thomas ascertained that the *Koorkoos* and other tribes know the insect, but make no use of the sugary secretion, which they say has a narcotic effect when eaten. To this Mr. R. H. E. Thompson adds that he has found the insect both in several of the warmer valleys of the North-Western Himalayas, and also at elevations, ranging from a thousand to fifteen hundred feet above sea-level, in the forest-clad country of the Central Provinces to the south of the river Ganges. He notices that in Garhwal the natives eat the sugary secretion and call the insects *Dhaberi*, *i.e.* "sheep," on account of their habit of clustering together and jumping away when disturbed.

In the collections of the Indian Museum are representatives of the species from Dehra Dun, Sikkim, Naga Hills, Cachar, Margherita (Assam), Tavoy, and Siam.

CALCUTTA :
6th May 1891.

E. C. COTES,
Indian Museum.

Government of India Central Printing Office.—No. 248 R. & A.—5-10-91.—1,000.—F. T. B.

Fig 1. CEROPLASTES CERIFERUS

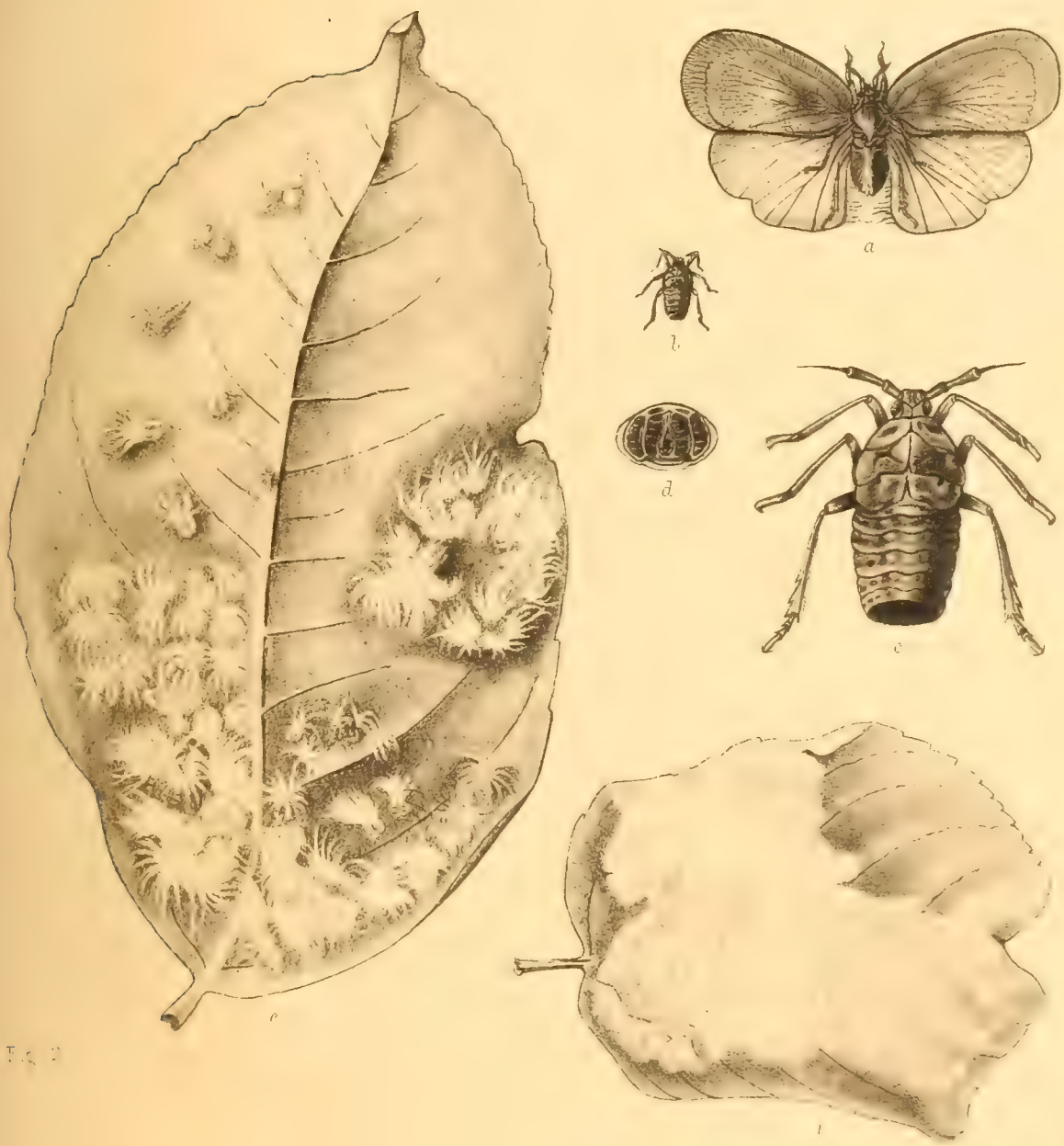

Fig 2. PHROMNIA MARGINELLA.

C.Chukrabotty.del.

Photo-etching from the original Drawings - Survey of India Offices, Calcutta, August 1891

EXPLANATION OF PLATE.

Fig. 1. *Ceroplastes ceriferus;* twig with three wax-covered females, nat. size.

Fig. 2. *Phromnia marginella;* a, imago natural size; b and c larvæ, natural size and enlarged, in each case divested of the flocculent matter with which they are ordinarily covered; d, gland like organs situated at the extremity of the abdomen in the larva, enlarged; e, leaf covered with dried larval skins as they appear before being divested of their flocculent coverings, nat. size; f., leaf covered with the sugary secretion emitted by the larvæ.